Ore Body Definition and Valuation

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Mining Cycle

Exploration

Mining

Refining

Product

Rehabilitation

Photos Courtesy Falconbridge Nickel

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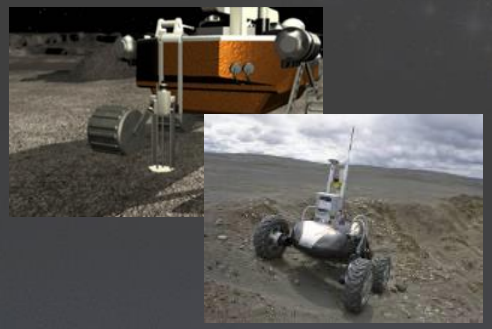
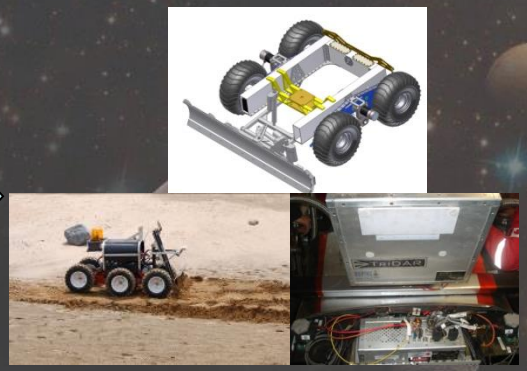
ISRU Cycle (Space Mining)

Remote Survey

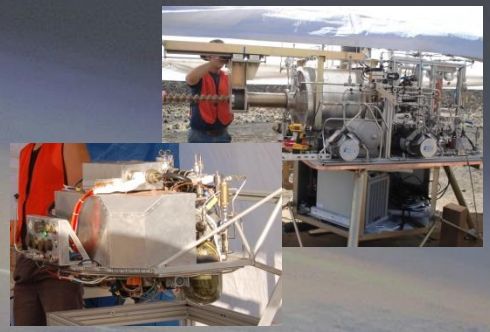
Resource Prospecting and Definition



Extraction Mining



Beneficiation



Processing

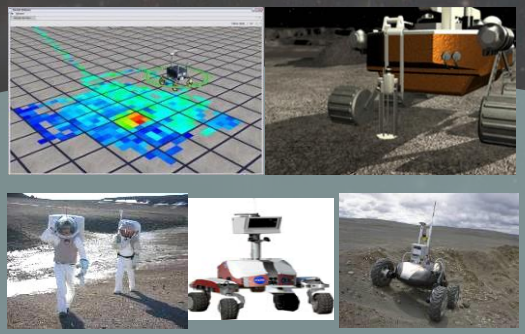
Product

Waste

Lunar ISRU Operations Cycle

Global Resource Identification

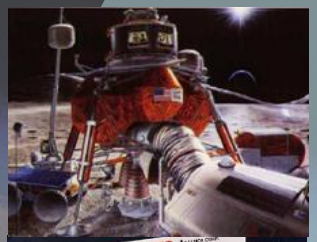
Local Resource Exploration/Planning



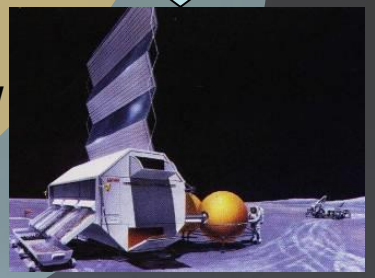
Mining

Site Preparation

Communication & Autonomy

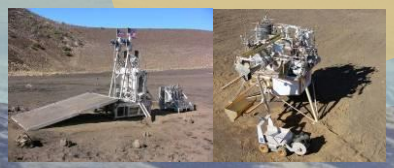


Maintenance & Repair



Crushing/Sizing/ Beneficiation

Processing



Product & Utilization

Waste

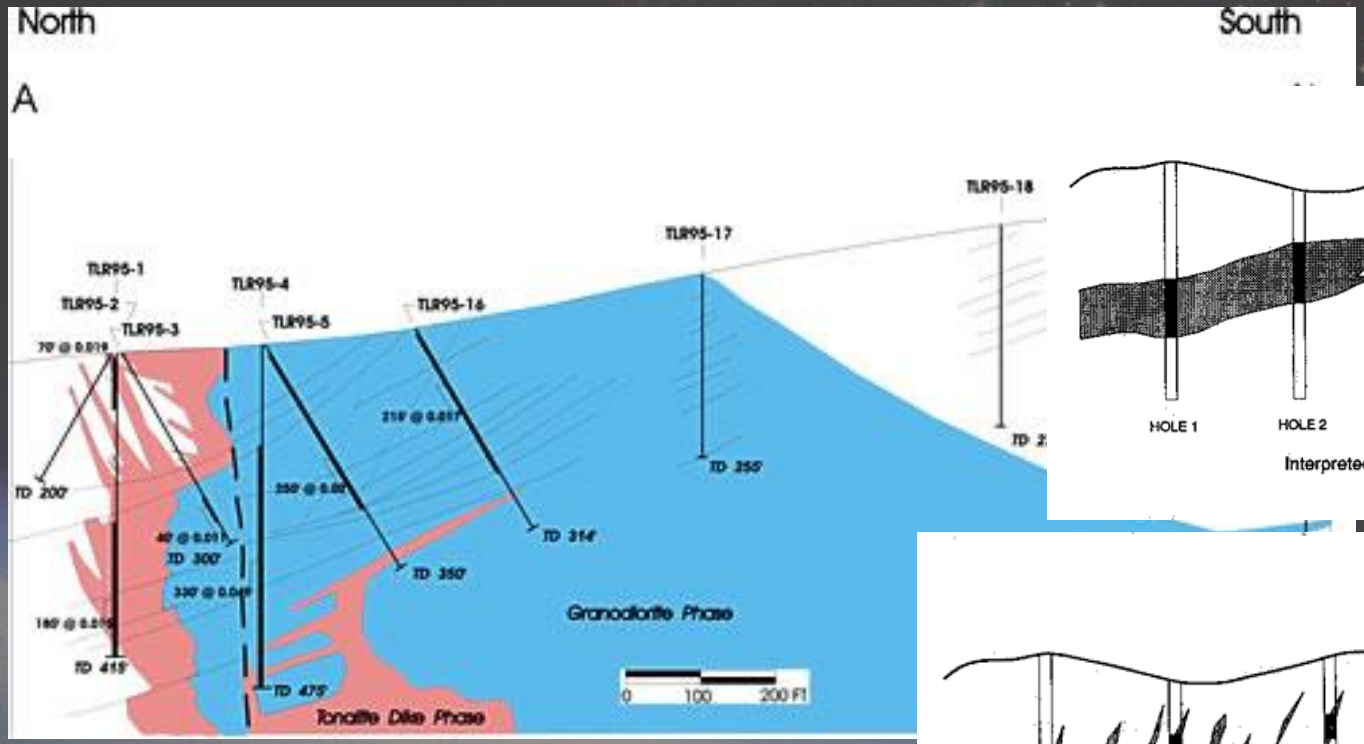
Prospecting 101

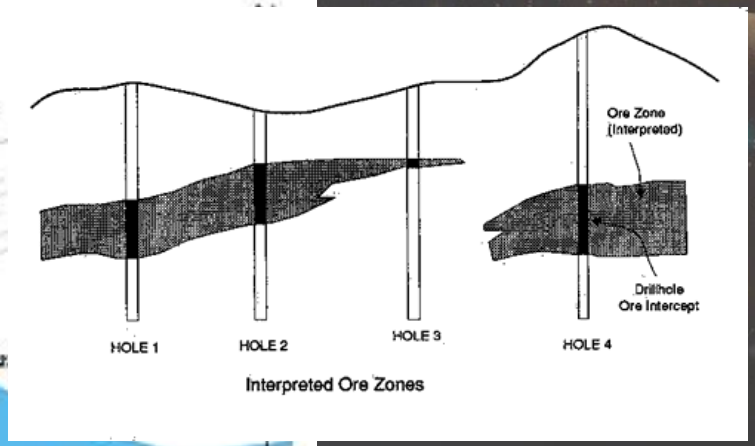
- Exploration
  - step-wise sequence to develop ore body valuation.
  - Geological reconnaissance, surface geochemical, and geophysical surveys prevail
  - exploratory drill holes on select targets
- Feasibility drilling stage.
  - close-spaced drilling (“development drilling”)
  - outlines deposit geometry in detail.
  - extensive testing to precisely determine grade of deposit and the “recovery”
  - “reserve drilling” for final assessment
  - actual mining or extraction method is proposed,
  - considers economic variables (commodity price, milling cost, transportation cost
  - mine the deposit from the surface (“open-pit mining”), or to mine the deposit by tunneling (“underground mining”).
- throughout the life of the mine,
  - further definition required
  - refine the deposit model.

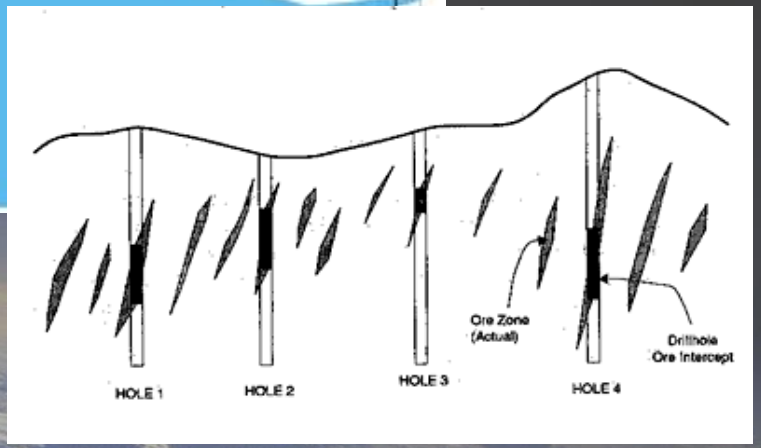
Prospecting 101

- valuation of ore body ("deposit")
  - "tonnage" (or volume)
    - drill data to delineate subsurface deposit,
    - geometric models to calculate the volume.
    - irregular shaped deposits introduce delineation error
  - "grade" (or concentration)
    - numerous assays to determine average concentration
    - evaluation of "purity" (how is the ore "bound")
    - can vary considerably within different parts of the same ore body.

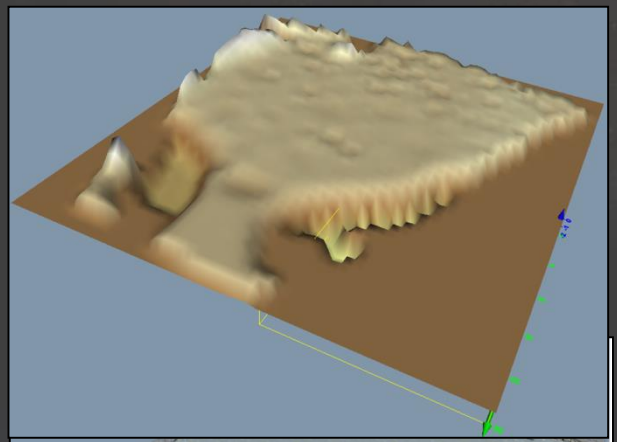
Prospecting 101

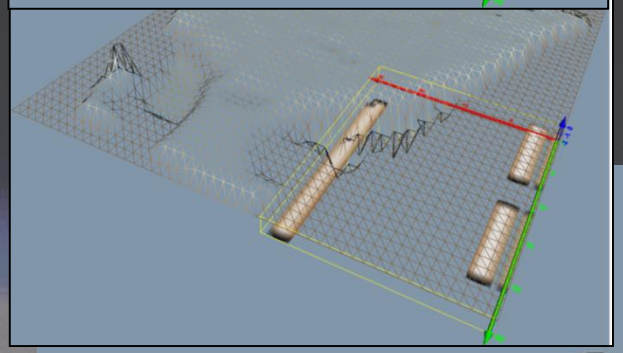


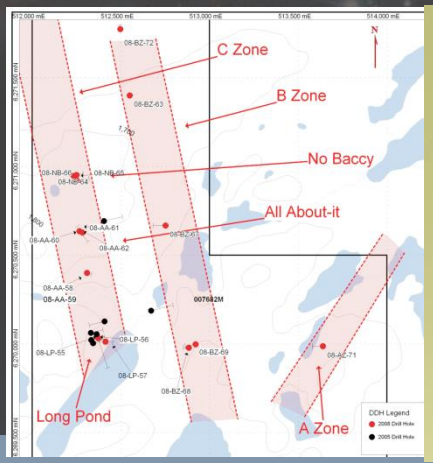


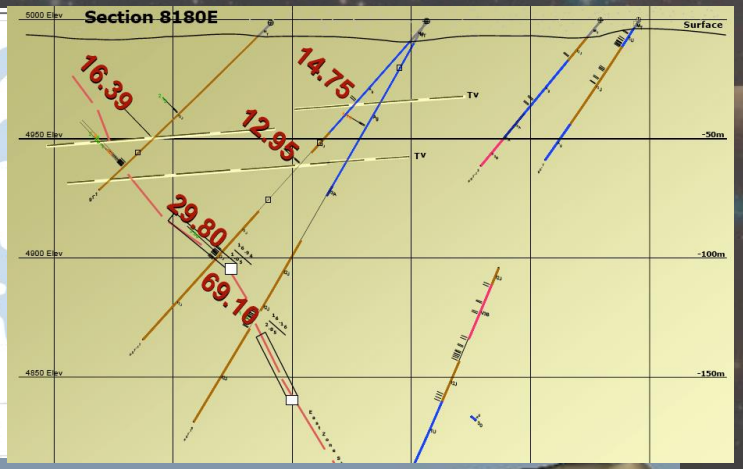


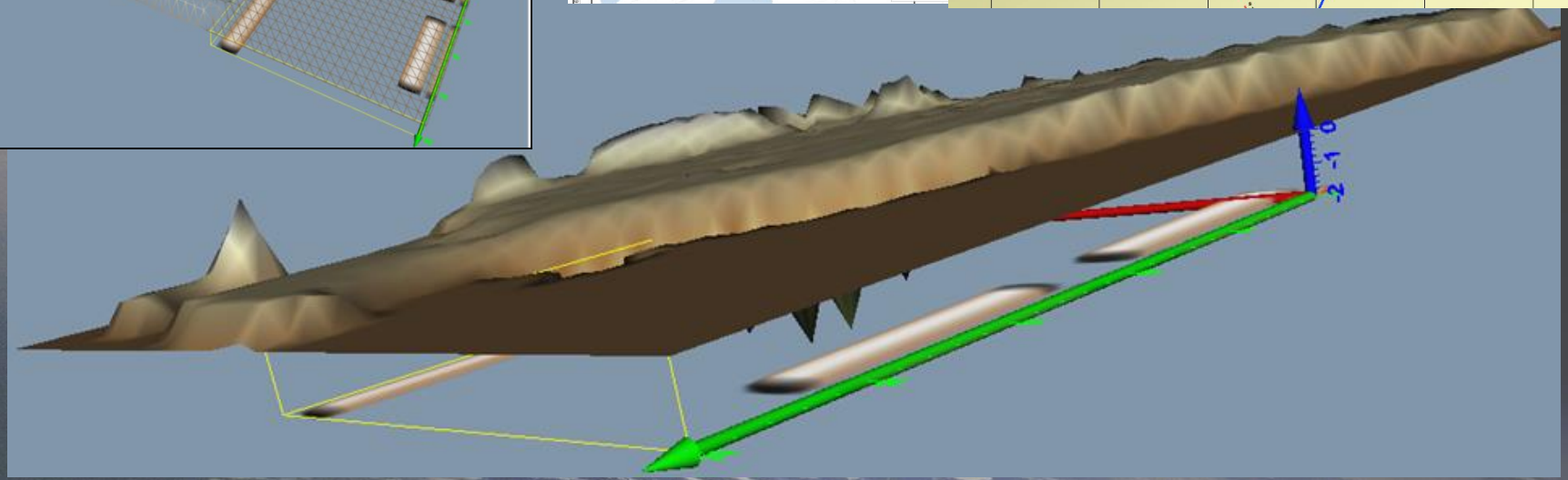
Prospecting 101











Definition and Assay Methods

- Grade and tonnage evaluations require sample analysis
- Method A: scoop a suite of samples from surface (shallow trenching or “spot” sampling)
  - relies on meteoritic gardening to provide statistically relevant mixing of “ores”
  - Requires a statistically large number of samples
  - Provides weak connection to depth data (no clear definition of stratification, if any)
    - This is required to determine the amount of work required to access the ore (ie overburden, waste removal, trenching methods, etc)
  - Results in 2 D map of “ore body”
- Method B: drill and sample
  - Allows definition of ore in 3rd dimension (depth) (stratification must be maintained during sampling)
  - Requires statistically large number of samples
  - Results in 3D map of ore body
- Sample analysis must be performed (use LIBS, for example)
  - Provides analysis of each sample with indication of grade and vertical position

Mining Design

- Post Assay will yield:
  - Ore body delineation with grade and accessibility (feasibility) definitions
  - Excavation technique required
  - Pilot plant design baseline data (list of “host” contaminants)
    - Do we keep the contaminants and refine those or toss em overboard
  - Refining methodology
  - Power budget
  - Mass budget
  - Time budget (hence ROI)
  - System build up requirements